

Assessment of Seawall
Structural Integrity
and
Potential for Seawall Over-Topping
For Balboa Island and Little Balboa Island

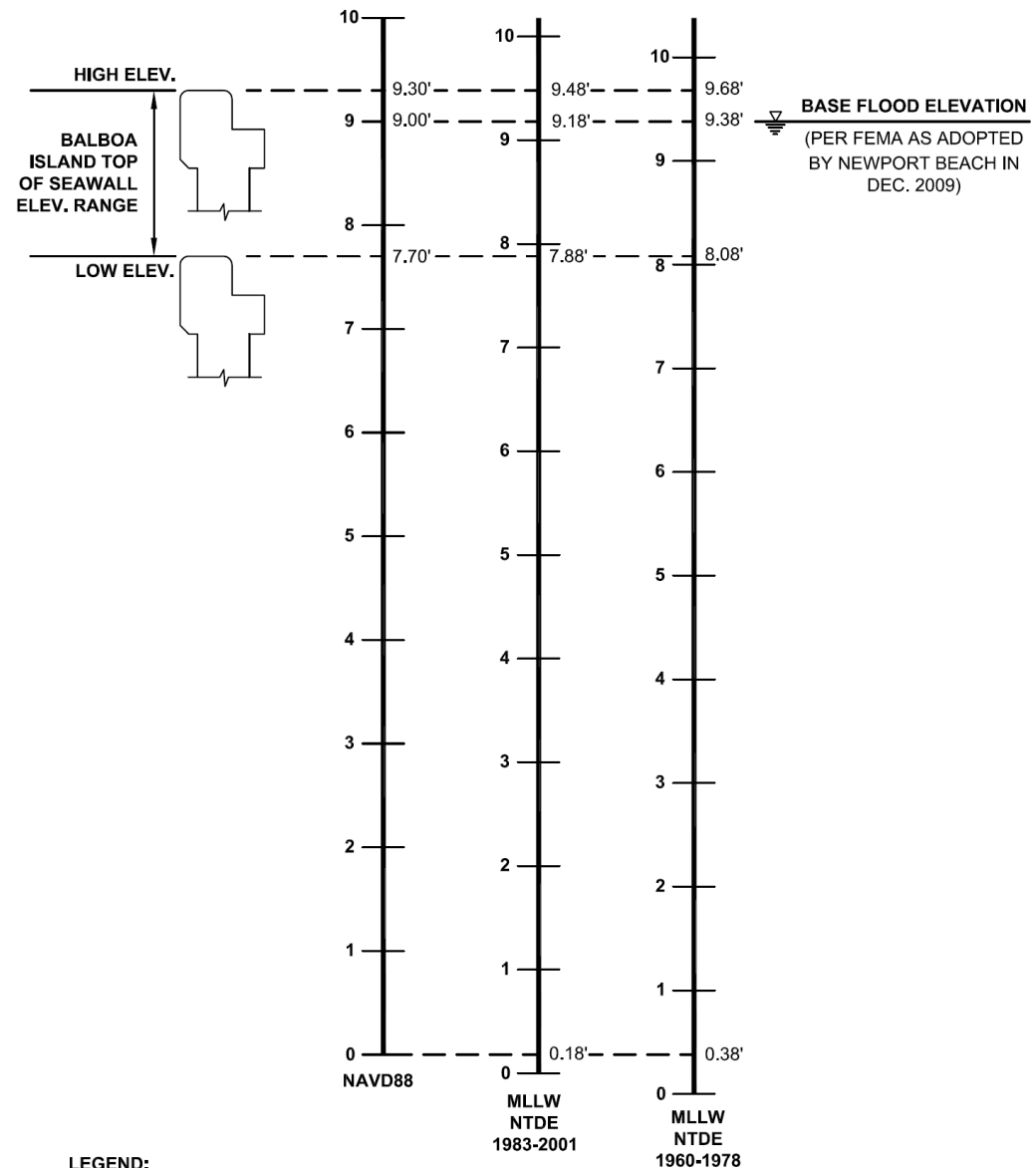
Tidelands Management Committee
May 18, 2011

Topics

1. Aging Seawall
2. Rising Seawater
3. Protection Options
4. Costs
5. Next Steps



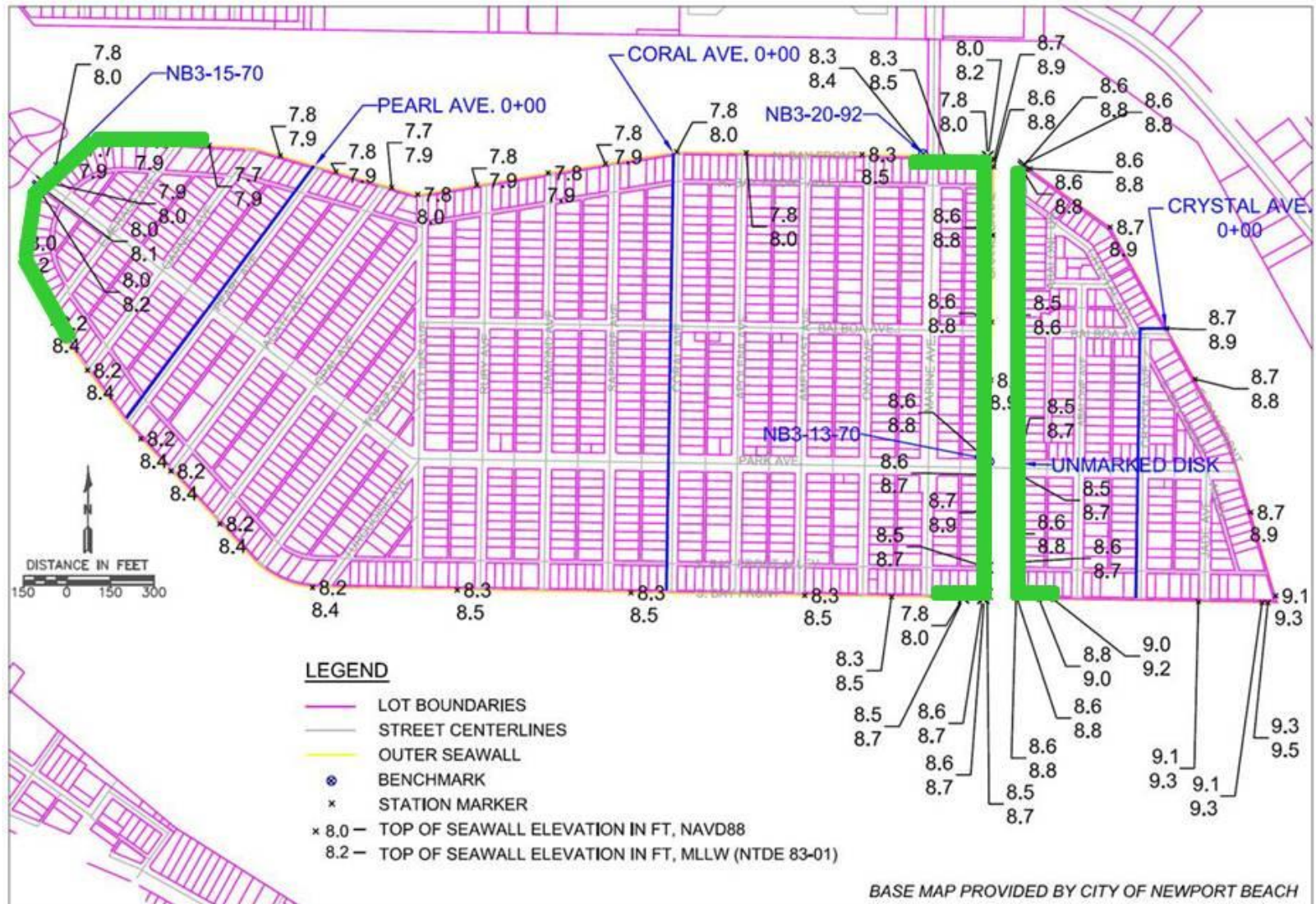
Comparison of different Land and Tidal Datums



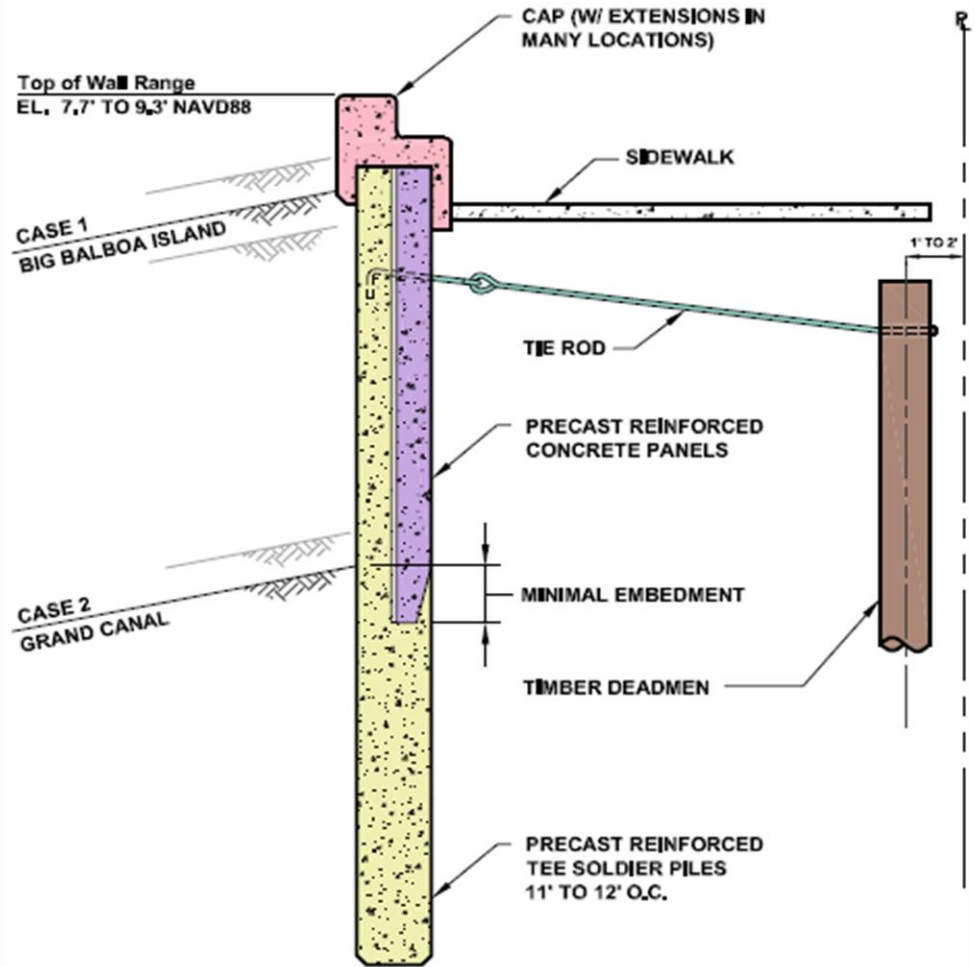
LEGEND:

- NTDE = NATIONAL TIDAL DATUM EPOCH
(A 19 YEAR PERIOD OVER WHICH TIDAL DATA IS COLLECTED AND REDUCED TO OBTAIN MEAN (AVERAGE) VALUES FOR TIDAL DATUMS)
- MLLW = MEAN LOWER LOW WATER
(RELATIVE DATUM BASED ON NTDE DATA)
- NAVD88 = NORTH AMERICAN VERTICAL DATUM 1988
(GEODETIC VERTICAL DATUM USING A SINGLE FIXED REFERENCE POINT)

Top of Seawall Elevation [ft]



Anatomy of a traditional Seawall



TYPICAL WALL CASES⁽¹⁾

⁽¹⁾ OTHER NON-TYPICAL
CONDITIONS EXIST

SK-1

DATE: 5/4/11



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CITY OF NEWPORT BEACH
3300 Newport Blvd.
Newport Beach, CA 92663

Little Balboa Seawall Cap Extension Constructed on top of Original Wall in 1988



Crack Repairs with Corroding Rebar



Earth Anchors at Balboa Island Ferry Landing



Sidewalk Separation from Seawall



Distresses in Bulkhead Cap



Seawall Condition

- Seawall Age: 73-82 years
- Overall Condition: Holding together well with widespread cracking and some concrete spalling and evidence of corroding rebar.
- Estimated Useful Life: 10-25 years

Waves Splashing over the Balboa Island Seawall at Turquoise Avenue and South Bay Front

(December 22, 2010)



City Personnel Pumping Flood Water Back into the Bay at Turquoise Ave and South Bay Front

(December 22, 2010)



Street Flooding Overtopping Curb

(December 22, 2010)



Flood Inundation Modeling

Seawall overtopping depends on:

1. Seawall elevation
 - a. Existing
 - b. w/ 6-inch cap
 - c. w/ new of seawall at Elev. 10.0'
MLLW
2. Predicted Future Seawater level

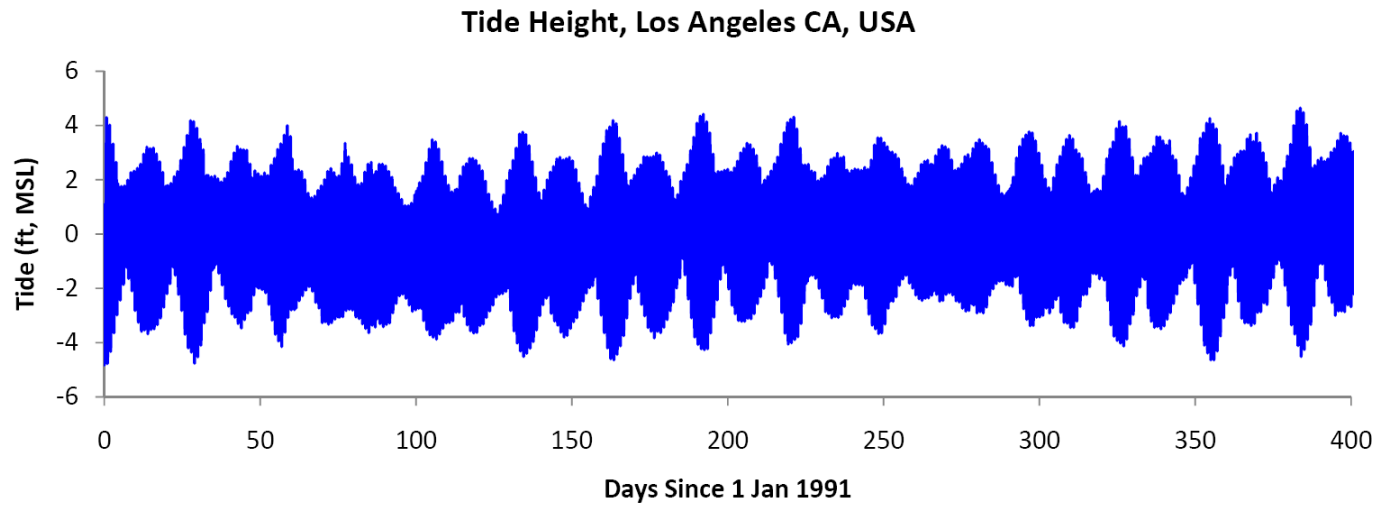
Predicting Seawater Level

Model accounts for:

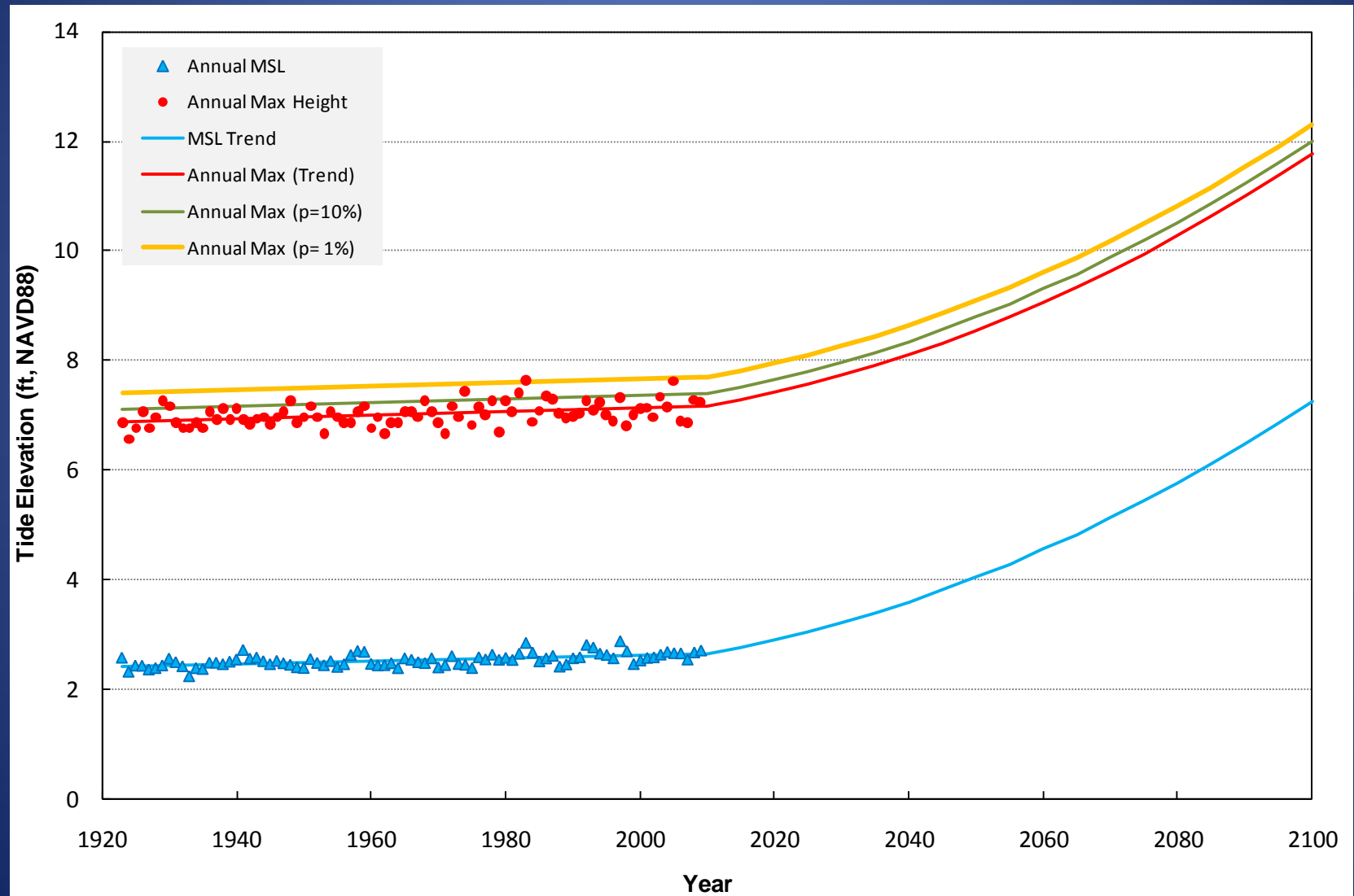
1. Extreme high tide
2. Expected rise is mean sea level
3. Ocean swell or wind waves

Extreme High Tide

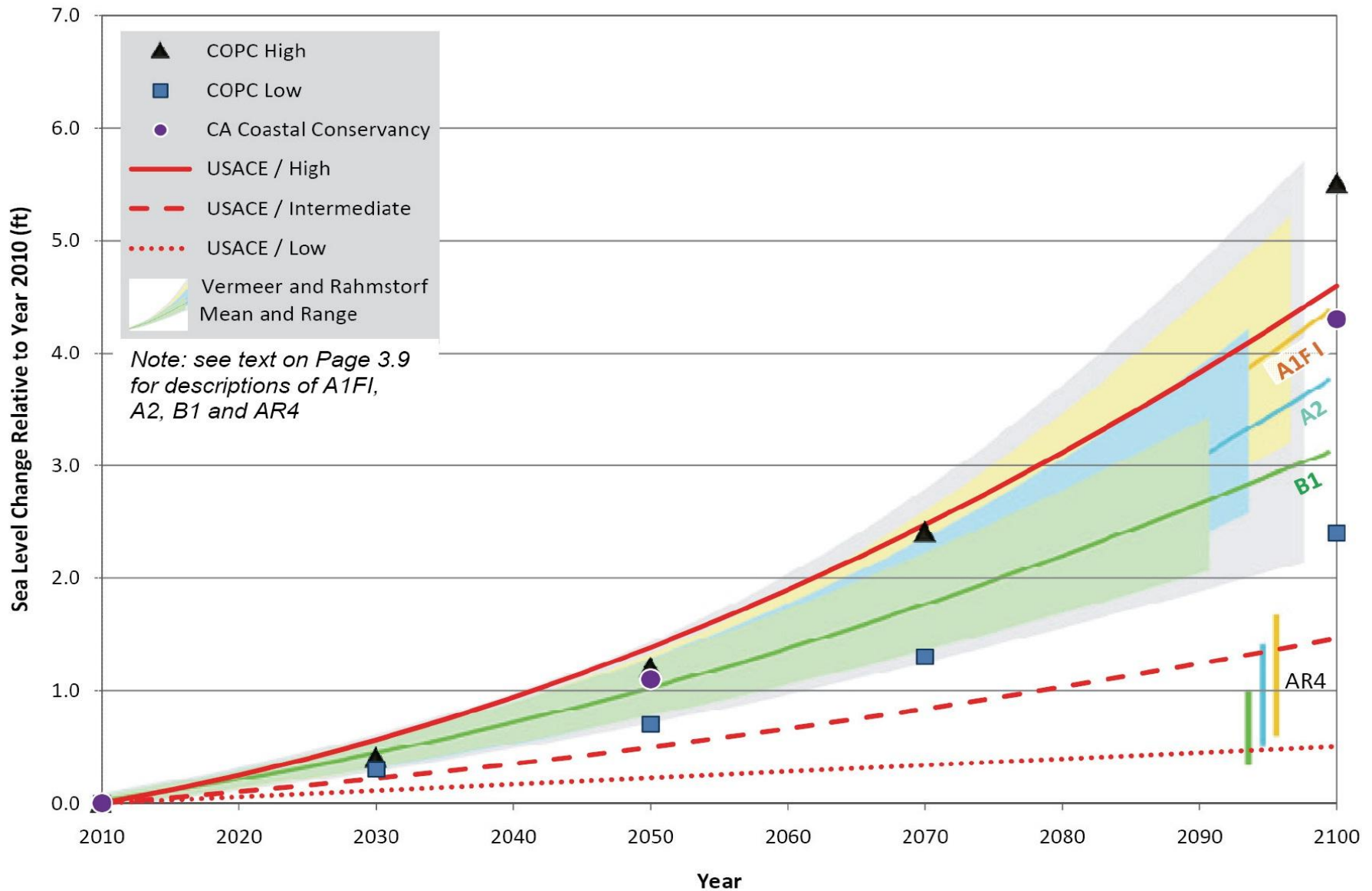
Extreme High Tide



Projections of Mean Sea Level and Extreme Tide Heights Through Year 2100



Sea Level Rise Projections



Sea Level and Annual Maximum Tide Height Projections Through Year 2100

YEAR	MEAN SEA LEVEL (FT, NAVD88)	10% TIDE HEIGHT (FT, NAVD88)	1% TIDE HEIGHT (FT, NAVD88)	PROJECTED SEA LEVEL RISE (FT)*
2010	2.65	7.41	7.71	-
2025	3.05	7.81	8.11	0.40
2050	4.03	8.79	9.09	1.38
2100	7.25	12.01	12.31	4.60

* equals change in mean sea level from Year 2010.

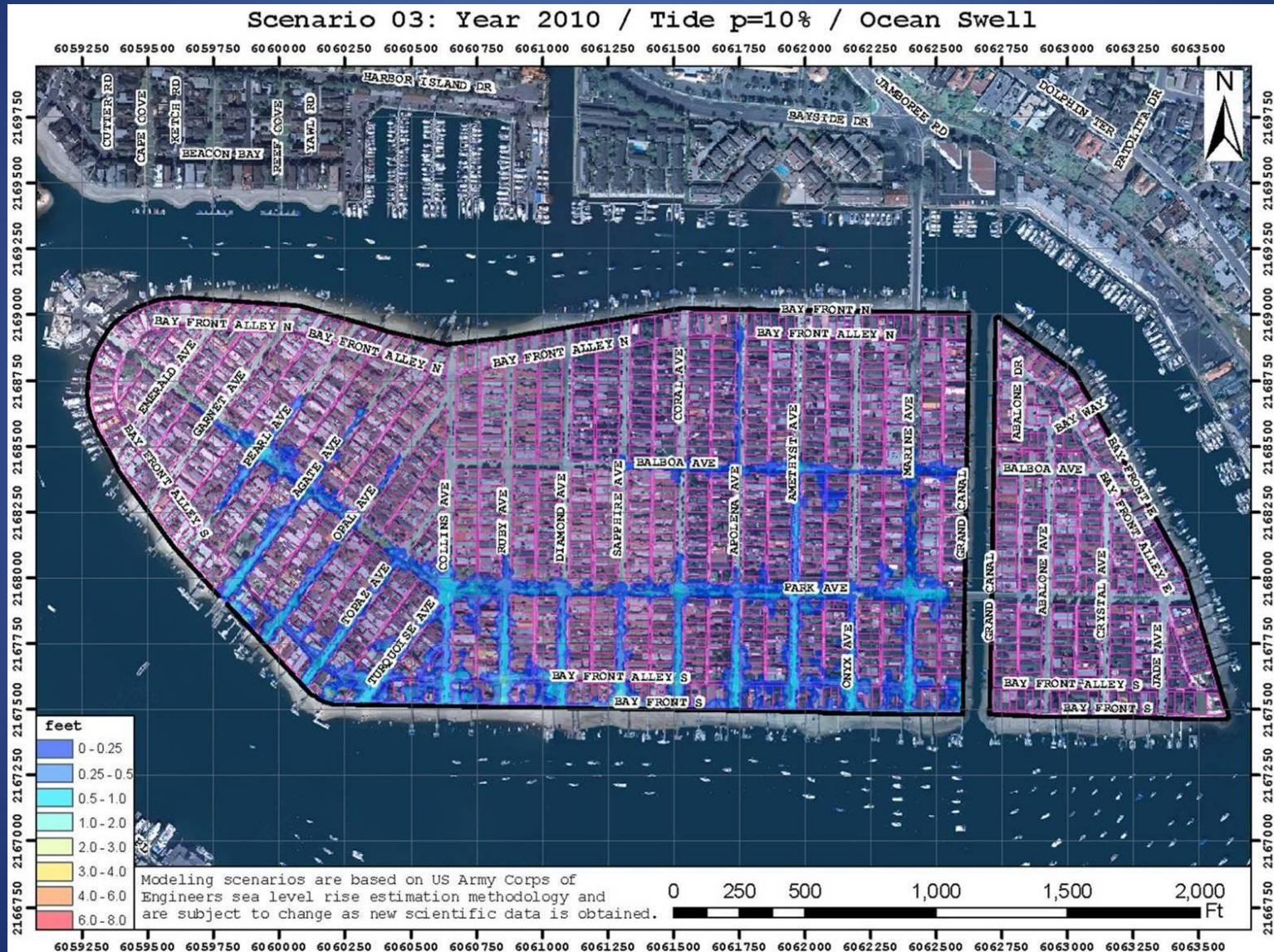
Flood Inundation Modeling Scenarios

SCENARIO	SEAWALL CONDITION	YEAR	SEA LEVEL RISE FROM 2010	TIDE HEIGHT (ANNUAL EXCEEDANCE PROBABILITY)	WAVE SCENARIO
1	Existing Conditions	2010	NA	10%	No Waves
2	Existing Conditions	2010	NA	10%	Wind Waves
3	Existing Conditions	2010	NA	10%	Ocean Swell
4	Existing Conditions	2010	NA	1%	Wind Waves
5	Existing Conditions	2025	0.40 ft	10%	Wind Waves
6	Existing Conditions	2025	0.40 ft	10%	Ocean Swell
7	Existing Conditions	2025	0.40 ft	1%	Wind Waves
8	Existing Conditions	2050	1.38 ft	10%	No Waves
9	Existing Conditions	2050	1.38 ft	1%	No Waves
10	Existing Conditions	2100	4.60 ft	10%	No Waves
11	6-inch extension	2010	NA	1%	Wind Waves
12	6-inch extension	2025	0.40 ft	1%	Wind Waves
13	10 ft (MLLW) seawall	2010	NA	1%	Wind Waves
14	10 ft (MLLW) seawall	2025	0.40 ft	1%	Wind Waves
15	10 ft (MLLW) seawall	2050	1.38 ft	1%	Wind Waves
16	10 ft (MLLW) seawall	2050	1.38 ft	10%	Wind Waves
17	10 ft (MLLW) seawall	2100	4.60 ft	1%	Wind Waves

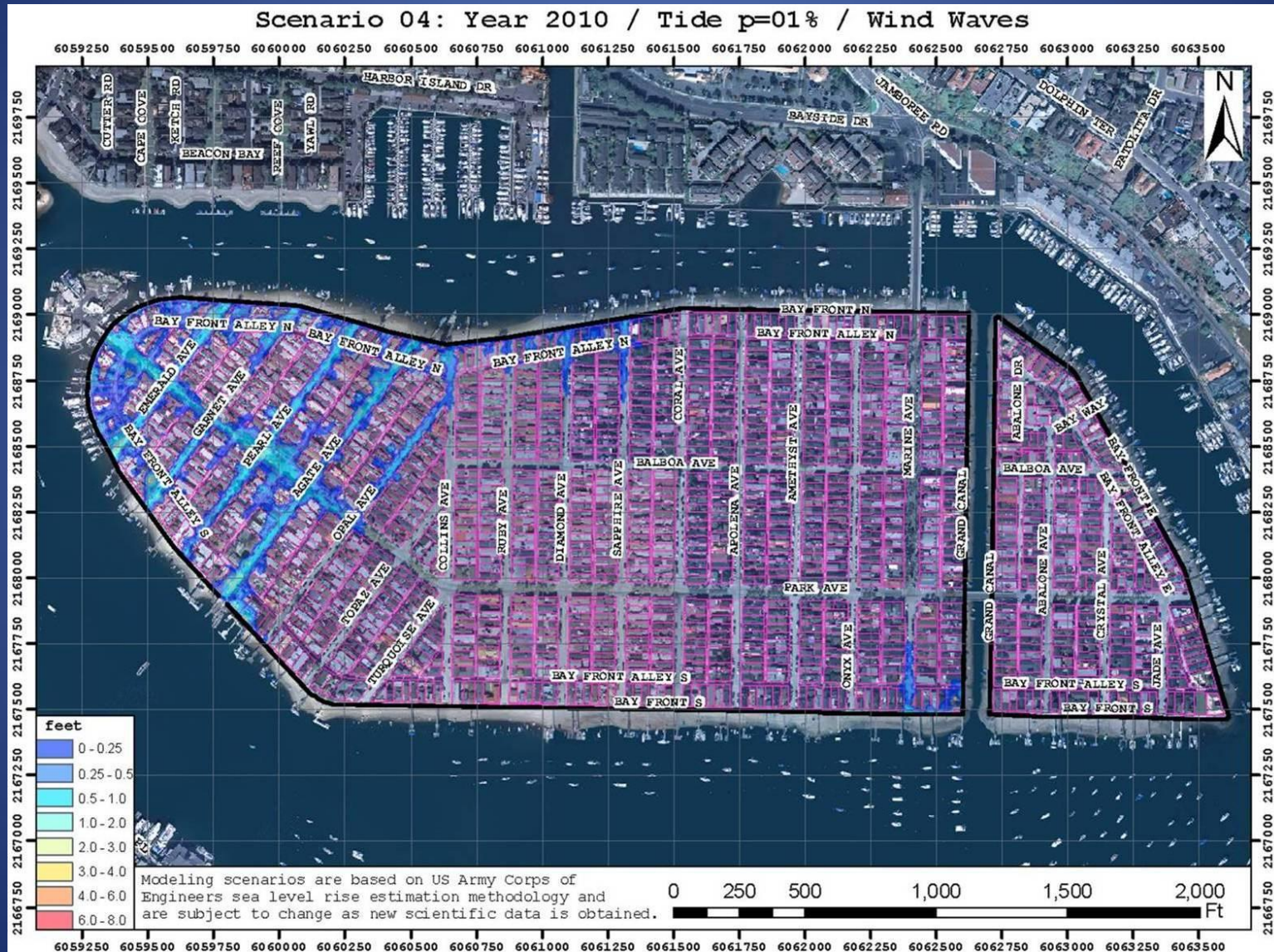
Average Flood Depth, Parcel and Building Impacts Associated with Each Model Scenario

SCENARIO	YEAR	TIDE HEIGHT (ANNUAL EXCEEDANCE PROBABILITY)	WAVE SCENARIO	AVERAGE * FLOOD DEPTH (FT)	IMPACTED** PARCELS (NUMBER)	PARCELS IMPACTED (%)	IMPACTED*** BUILDINGS (NUMBER)	IMPACTED BUILDINGS (%)	FLOOD EXTENT FIGURE NUMBER
Existing Condition Scenarios									
1	2010	10%	No Waves	0.26	61	4.0	3 ± 2	0.2	Figure 3.5
2	2010	10%	Wind Waves	0.26	61	4.3	3 ± 2	0.2	Figure 3.6
3	2010	10%	Ocean Swell	0.29	514	36.5	24 ± 5	1.7	Figure 3.7
4	2010	1%	Wind Waves	0.36	324	23.0	22 ± 4	1.5	Figure 3.8
5	2025	10%	Wind Waves	0.48	681	48.3	66 ± 7	4.7	Figure 3.9
6	2025	10%	Ocean Swell	0.79	1,176	83.4	235 ± 13	16.6	Figure 3.10
7	2025	1%	Wind Waves	1.16	1,179	83.6	420 ± 14	29.8	Figure 3.11
8	2050	10%	No Waves	1.84	1,410	100.0	894 ± 17	63.4	Figure 3.12
9	2050	1%	No Waves	2.15	1,410	100.0	1047 ± 15	74.3	Figure 3.13
10	2100	10%	No Waves	5.02	1,410	100.0	1410 ± 1	100.0	Figure 3.14
6-inch Extension Scenarios									
11	2010	1%	Wind Waves	0.03	0	0.0	0	0.0	Figure 3.15
12	2025	1%	Wind Waves	0.12	12	0.9	0-1	<0.1	Figure 3.16
10-foot Seawall Scenarios									
13	2010	1%	Wind Waves	0	0	0.0	0	0.0	Figure 3.17
14	2025	1%	Wind Waves	0	0	0.0	0	0.0	Figure 3.18
15	2050	1%	Wind Waves	0	0	0.0	0	0.0	Figure 3.19
16	2050	10%	Wind Waves	0	0	0.0	0	0.0	Figure 3.20
17	2100	1%	Wind Waves	5.30	1,410	100.0	1410 ± 1	100.0	Figure 3.21

2010 Flood Scenario 3: Ocean Swell



2010 Flood Scenario 4: Wind Waves



December 2010 Flooding on Turquoise

Extreme Tide $p=40\%$ w/ Ocean Swell

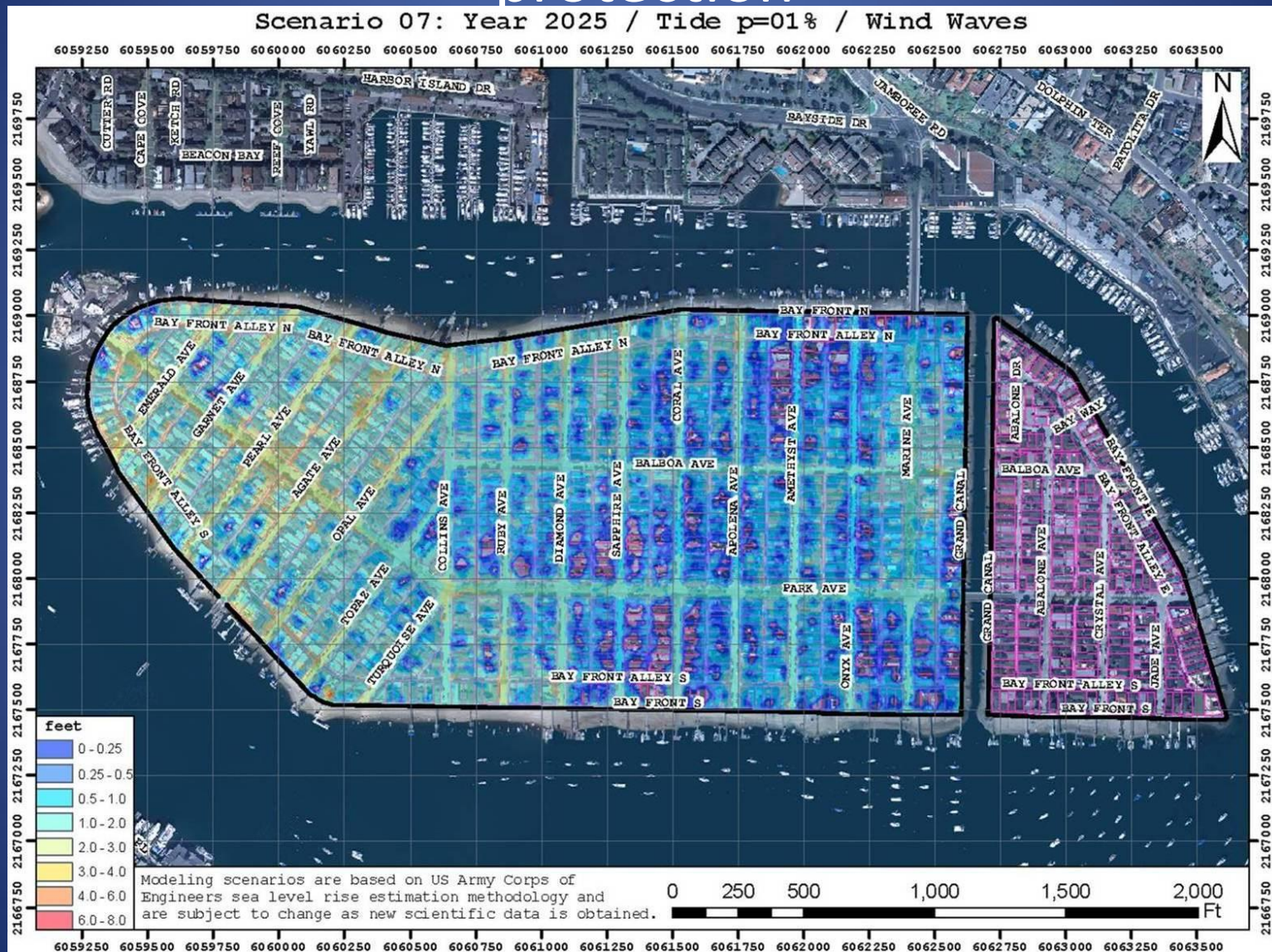


Flooding at Balboa Island Ferry Landing

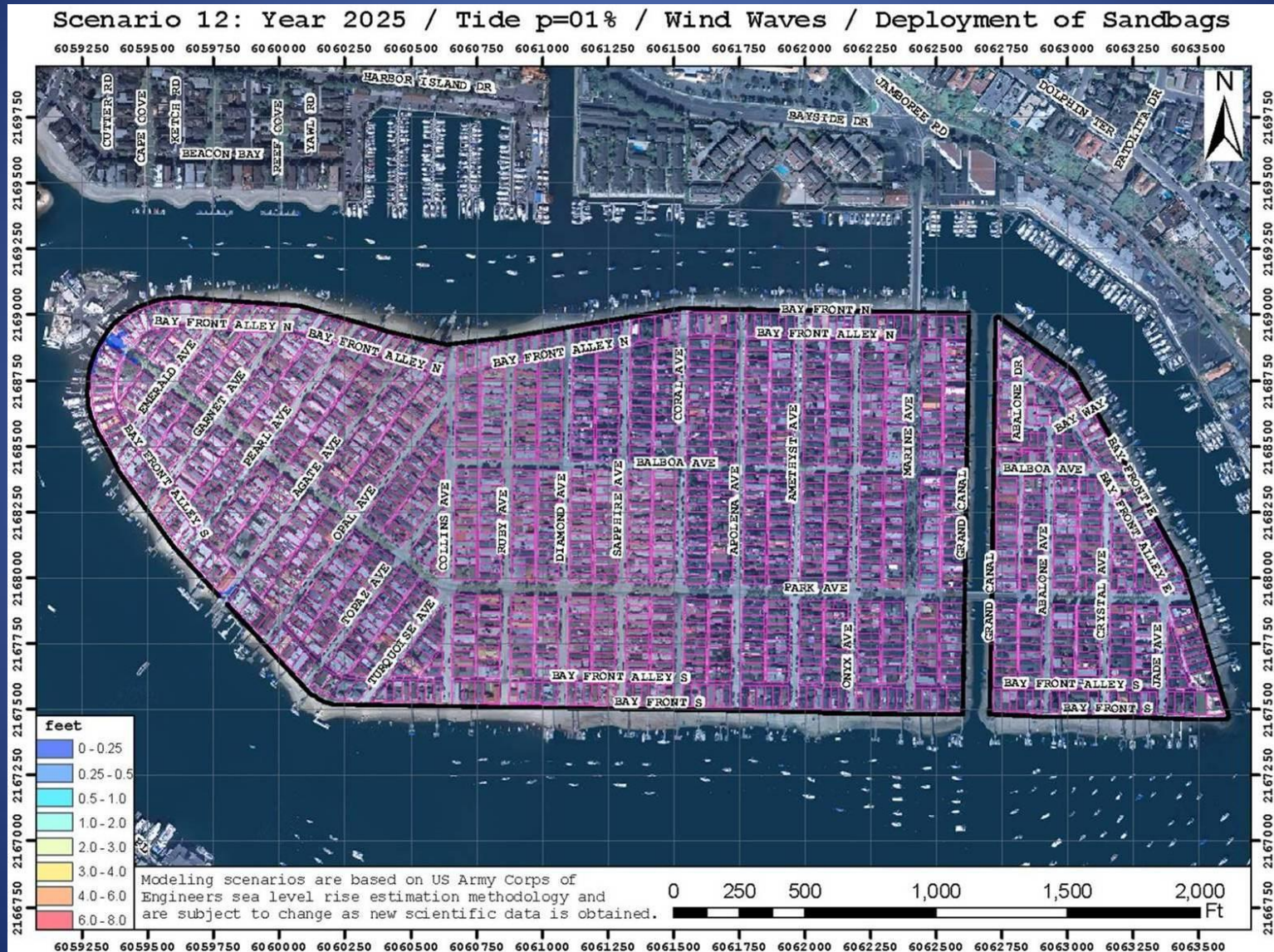
(2005 Flood Event)



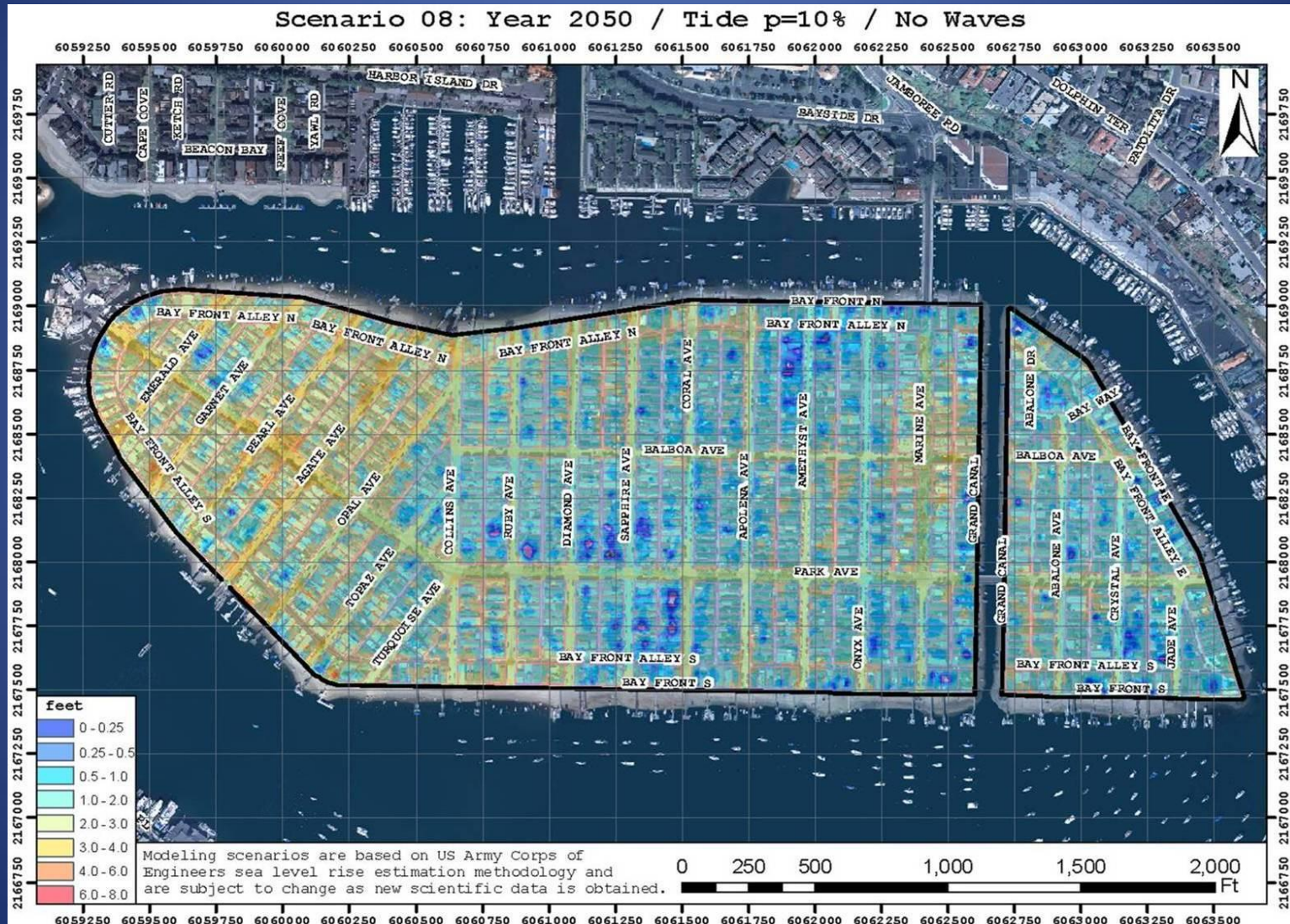
2025 Flood Scenario 7: w/o additional protection



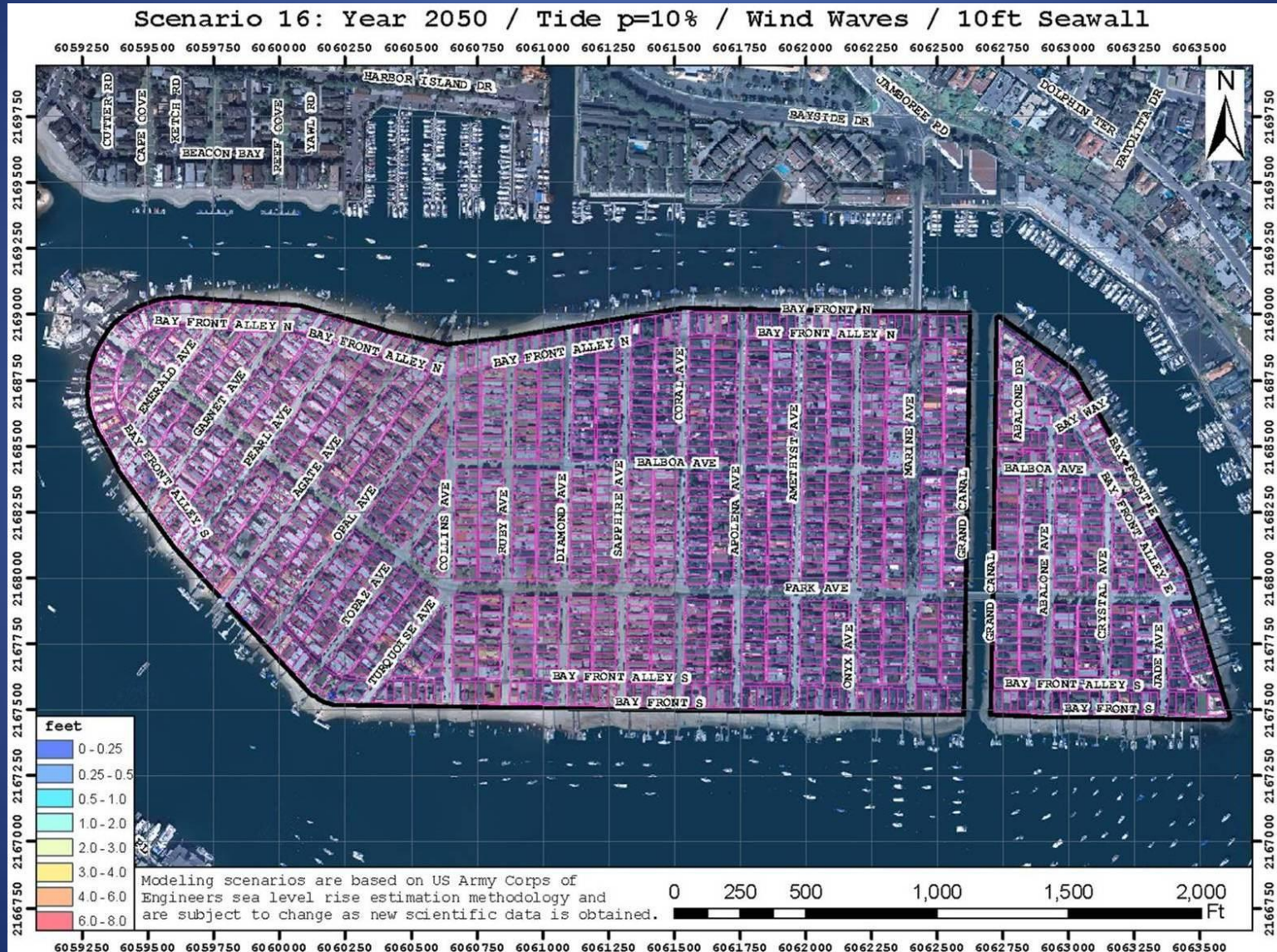
2025 Flood Scenario 12: w/ 6-inch cap



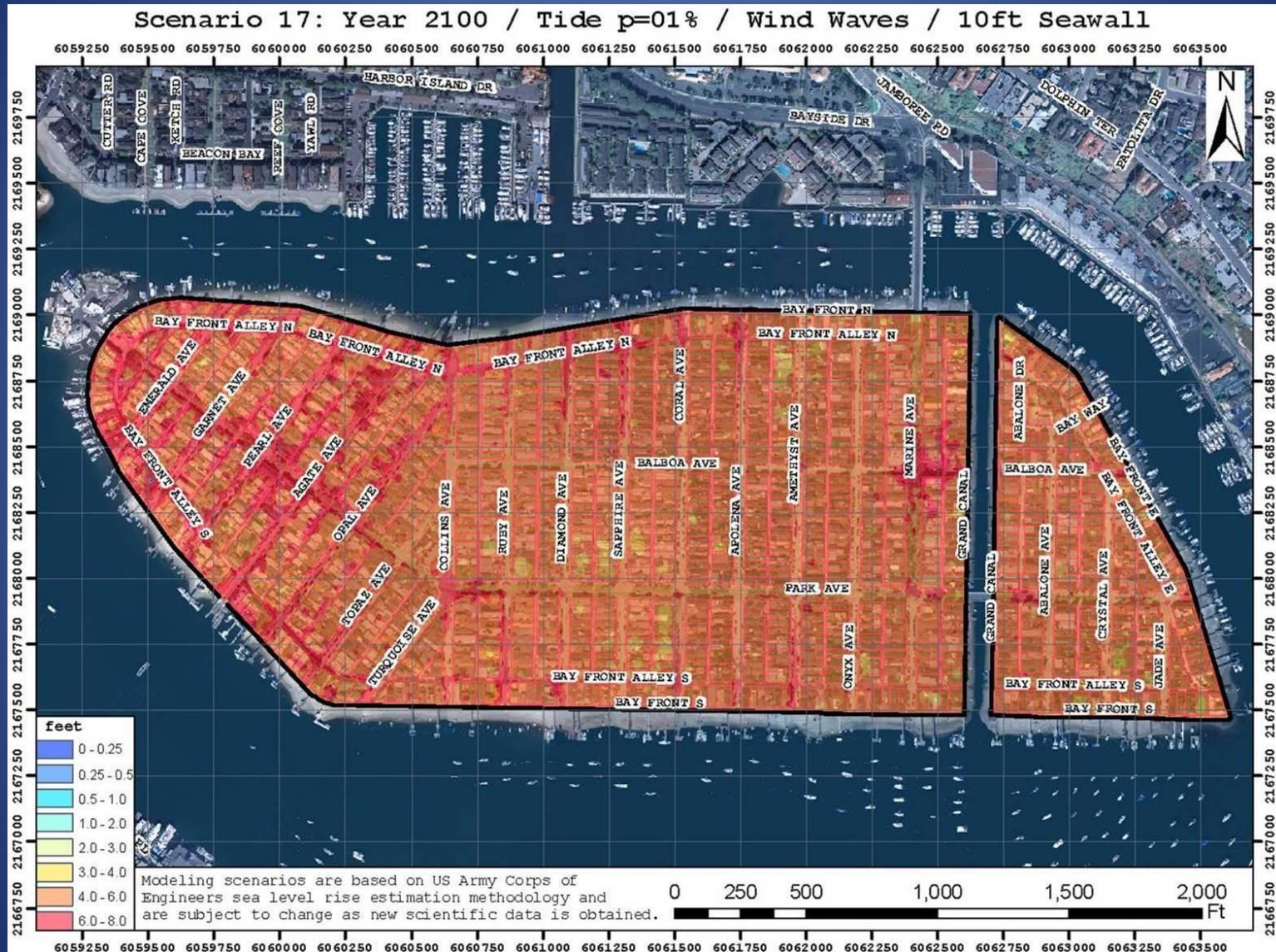
2050 Flood Scenario 8: w/o additional protection



2050 Flood Scenario 16 w/ New Seawall at 9.8 feet (NAVD88)



2100 Flood Scenario 17: w/o Seawall Extensions



Protection Option: Seawall Extension

1. Extend existing cap 6 inches
2. Remove existing cap and replace with 6-inch taller cap
3. Lower cost option: Use sandbags or geotextile bags



New Seawall – Option 1

H-piles and Concrete Wall (Lag) Panels

(No tiebacks)



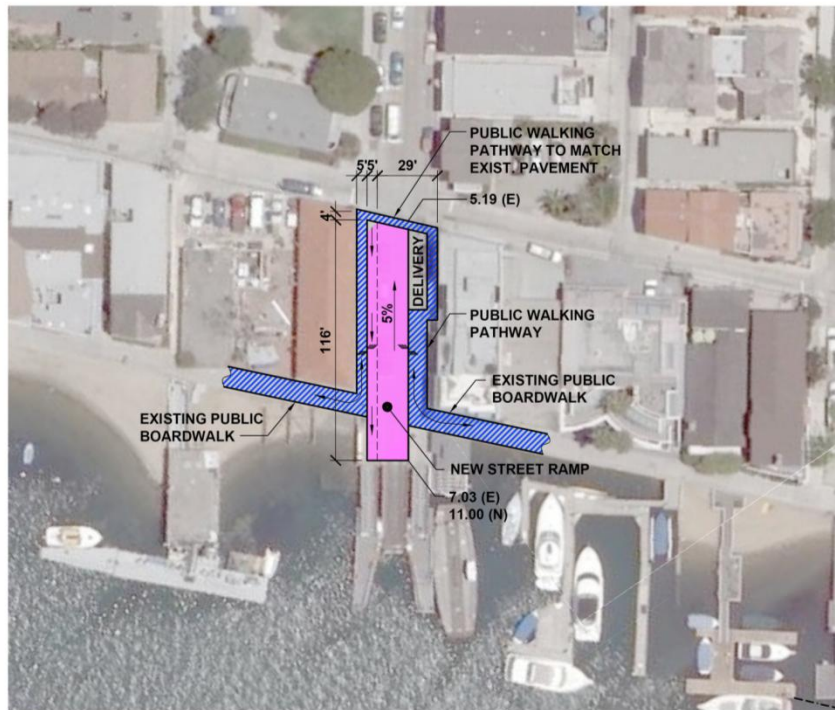
New Seawall – Option 2

Steel Sheet Pile Bulkhead

(No tiebacks)



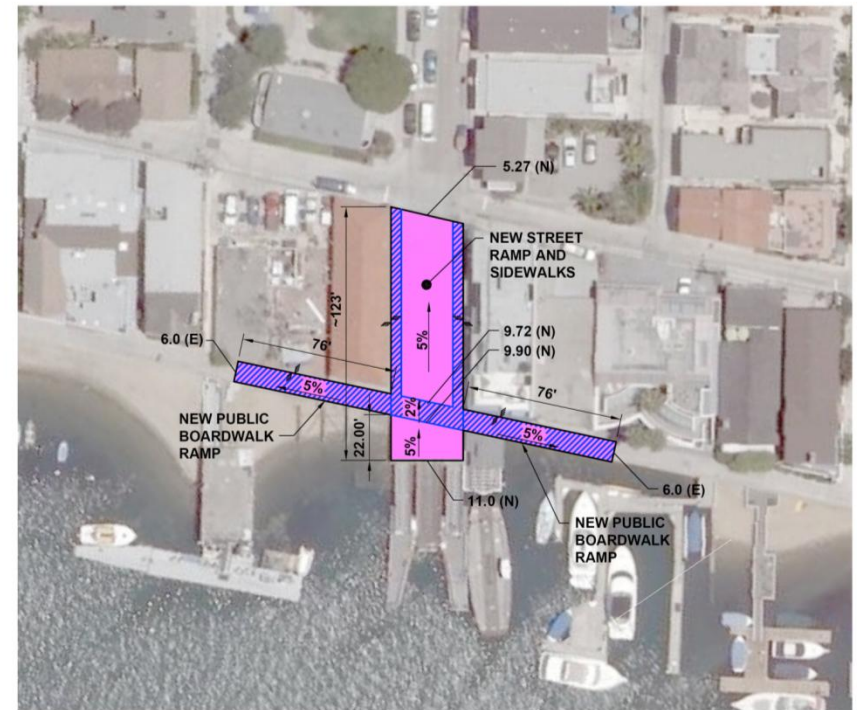
Two Options to Raise the Launch Ramp at Balboa Island Ferry Landing



Option 1

Street Approach Ramp with Diverted Walking Path

@ 8% : ELEV. 14.0



Option 2

Street Approach & Boardwalk Ramps

@ 8% : ELEV. 12.5

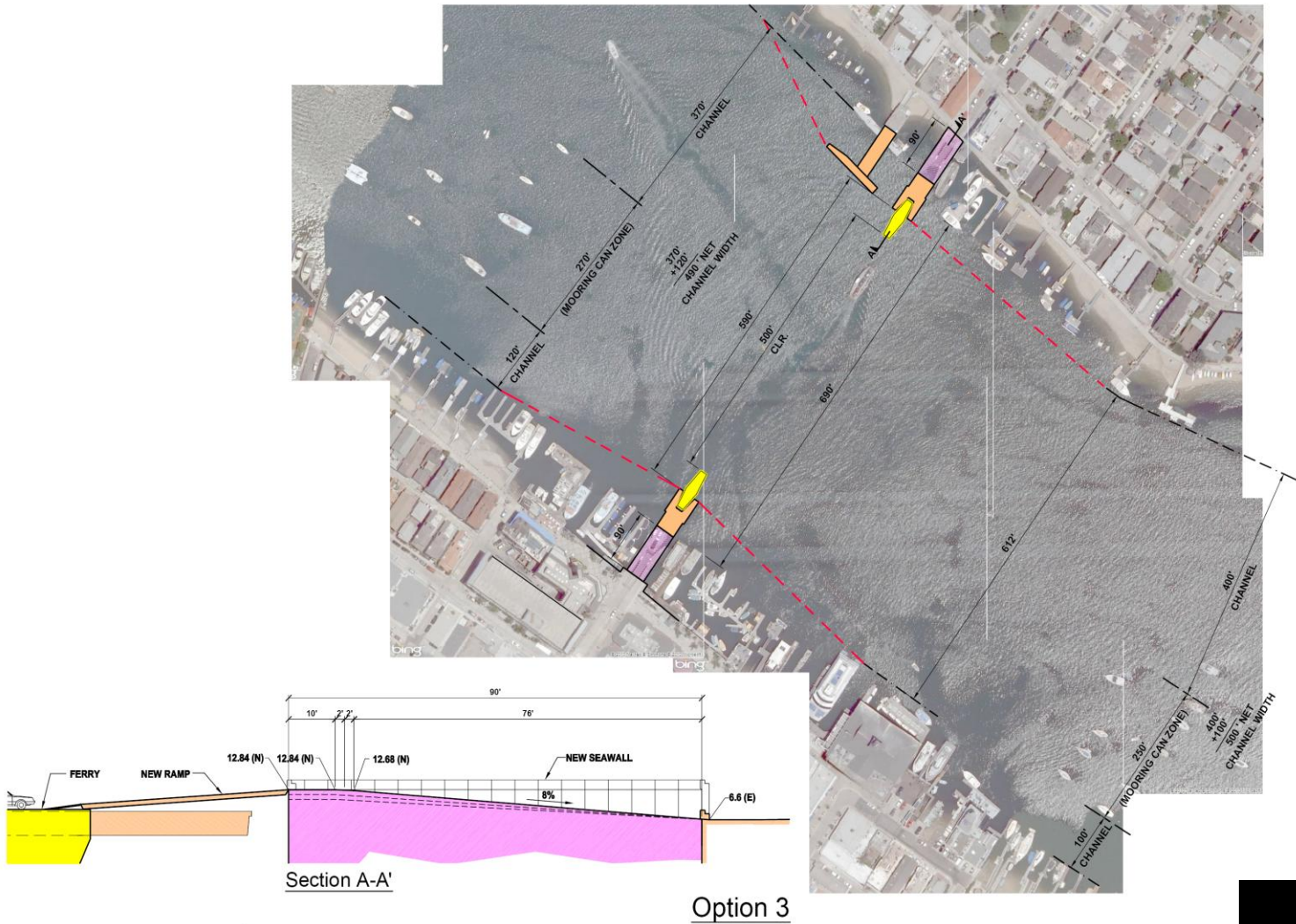


0 10' 20' 30' 60'

GRAPHIC SCALE

Datum: NAVD 88

Balboa Island Ferry Modification Option



Rising Groundwater

- First Floor Elevations: 6.2 to 11.6 feet (NAVD88)
- 2050 Groundwater elevation at High Water 6.1 feet
- 2100 Groundwater Elevation at High Water 9.3 feet

Seawall Construction Cost Estimates (Concept-Level)

MITIGATION COMPONENT	UNIT PRICE (\$/LF) ¹	CONCEPTUAL COST ²
<i>Interim Seawall Height Extension</i>		
Alt. 1: New Seawall Cap	\$625 - \$725	\$8.25 - \$9.57 million
Alt. 2: Existing Seawall Cap Extension		
Option 1: Mechanical Extension	\$250 - \$300	\$3.30 - \$3.63 million
Option 2: Polypropylene Sandbags	\$170 - \$190	\$2.26 - \$2.52 million
Option 3: Geotextile Bags/Tubes	\$130 - \$160	\$1.72 - \$2.12 million
<i>New Seawall</i>		
Option 1: Steel H-Piles w/ Conc. Panels	\$3,800 - \$4,000	\$50.20 - \$52.80 million
Option 2: Steel Sheet Piles	\$4,100 - \$4,300	\$54.10 - \$56.80 million
Subsequent Seawall Extension: 3 – 4 feet (When/If Required)	\$400 - \$500	\$5.30 - \$6.60 million
<i>Ferry Landing and Bridges</i>		
Ferry Boat Landing and Fuel Dock Retrofit (All 3 Options)		\$3.50 - \$5.00 million
Bridge Retrofit (3 bridges)	\$250,000 - \$350,000 per bridge	\$0.75 - \$1.05 million
Total Estimated Program Cost³		\$61.47 - \$79.02 million

Potential Funding for the Balboa Islands Seawalls

1. City funded feasibility studies
2. Assessment District Formation
3. Possibility of limited Federal or State Grants
4. Combination of funding

Recommend Plan to Move Forward

Phase 1 - Between 2011-2015

- a. Update City codes, Standards & Policies as necessary to plan for higher sea levels.
- b. Implement a Community Awareness Program
- c. Establish new Lowest Floor Elevation.
- d. Implement new Harbor-Wide Seawalls Height of Minimum 10 feet Nav 88.
- e. Begin Design & Permitting of Balboa Islands Seawall, Ferry Landing & Bridge Retrofit.
- f. Identify and Develop Funding Sources.
- g. Look to Elevate Infrastructure when Reconstructing.

Recommend Plan to Move Forward

Phase 2 - Between 2016-2020

- a. Construct New Seawalls around Both Islands with Top Elevation at 10' Nav 88.
- b. Look to Elevate Infrastructure when Reconstructing.
- c. Monitor and Evaluate Mean Sea Levels.

Phase 3 - 2021-2050

- a) Look to Elevate Infrastructure when Reconstructing.
- b) Monitor and Evaluate Mean Sea Levels.

Recommend Plan to Move Forward

Phase 4 - 2050-2060

- a) Monitor and Evaluate Mean Sea Levels.
- b) If needed, extend Seawalls to Elev. 13 or 14.
- c) If needed, Implement Dewatering System or Other Means to Address Groundwater.
- d) Look to Elevate Infrastructure when Reconstructing.

Public Works Department

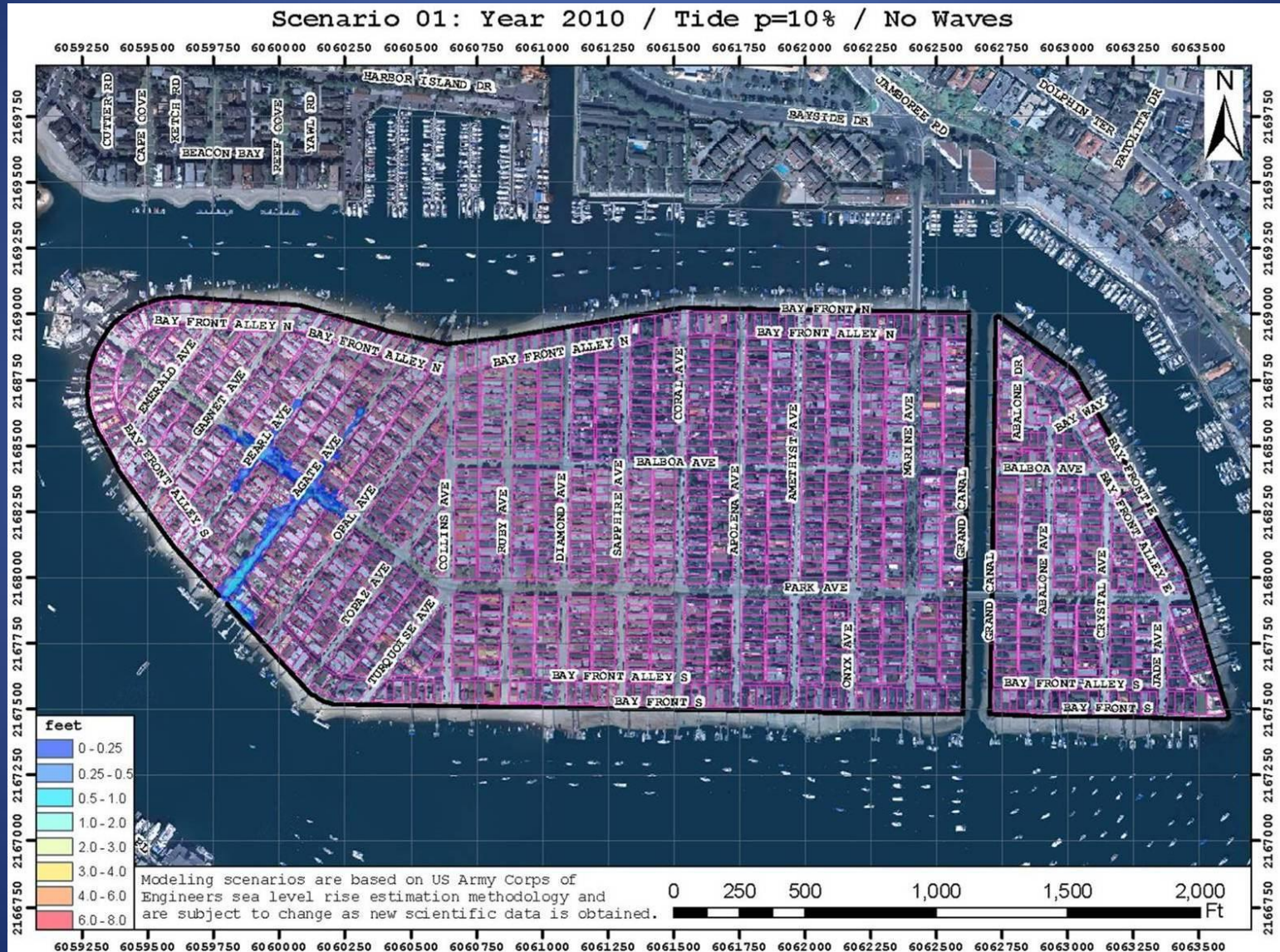
A Well-Engineered Machine

Protecting and Providing Quality Public
Improvements and Services

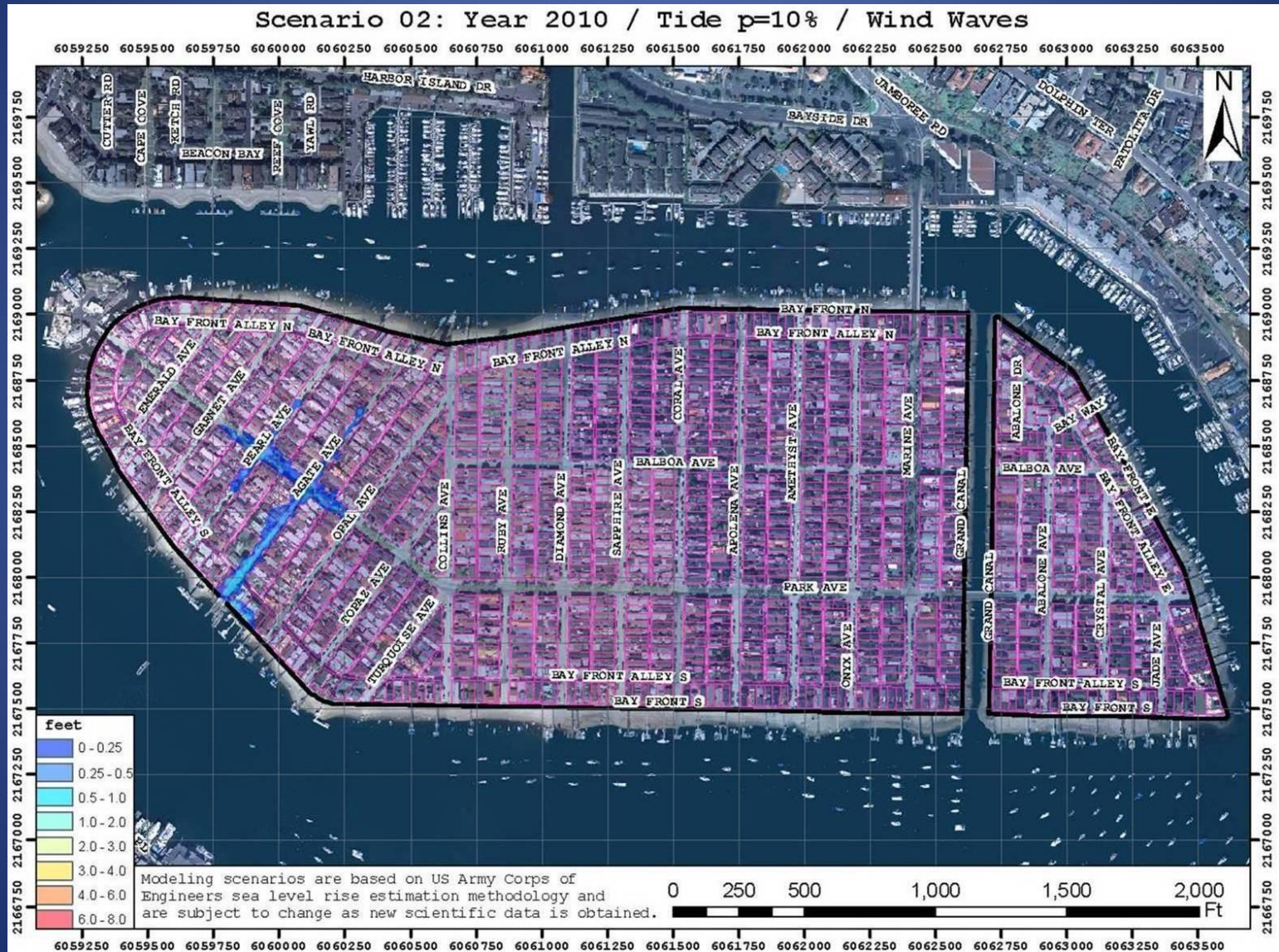


This presentation, as well as the complete Seawall Assessment and Potential Overtopping Report can be found at www.newportbeachca.gov/citymanager and then click on Tidelands Management Committee.

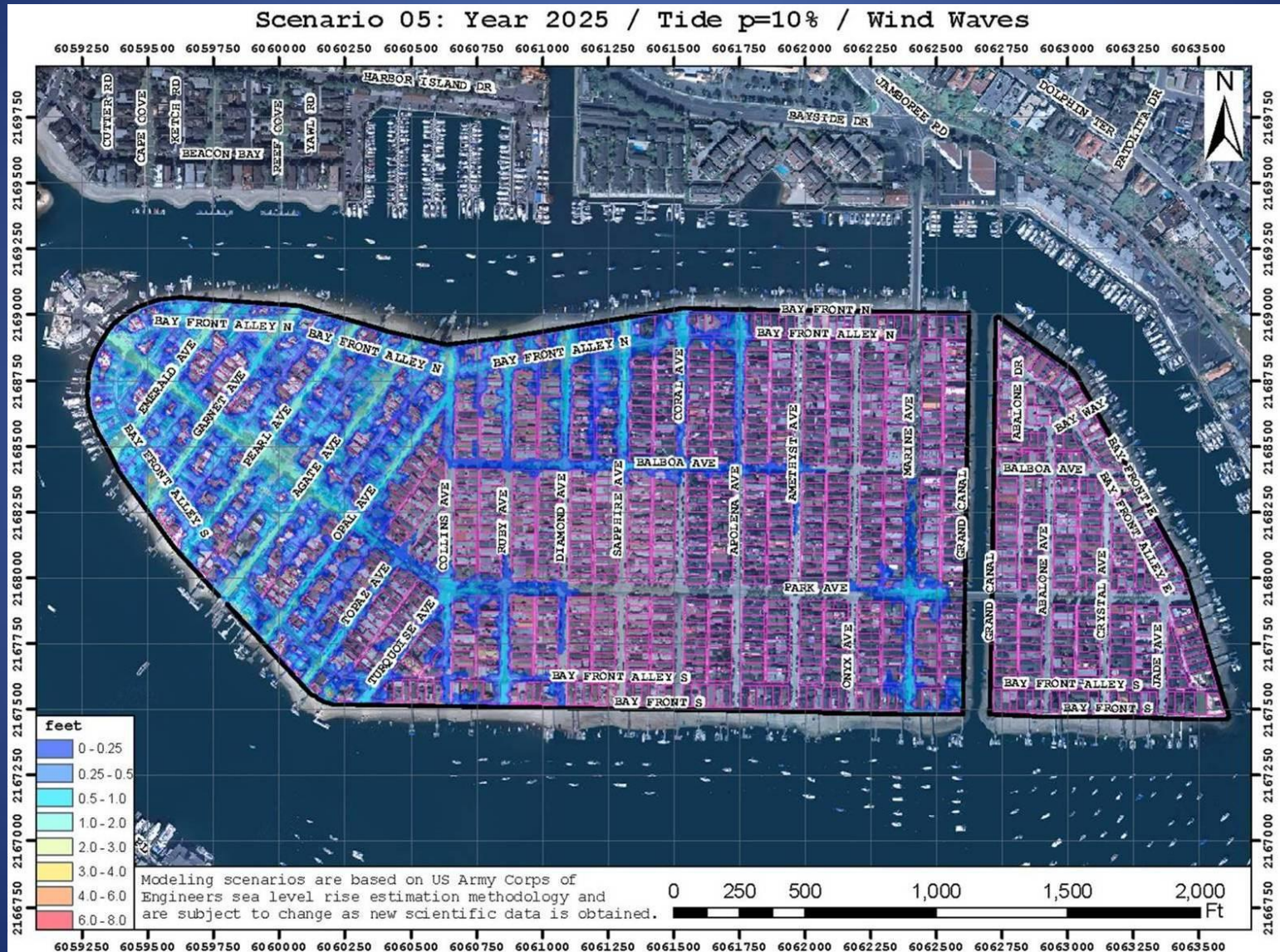
Flood Scenario 1



Flood Scenario 2



Flood Scenario 5



Flood Scenario 6

